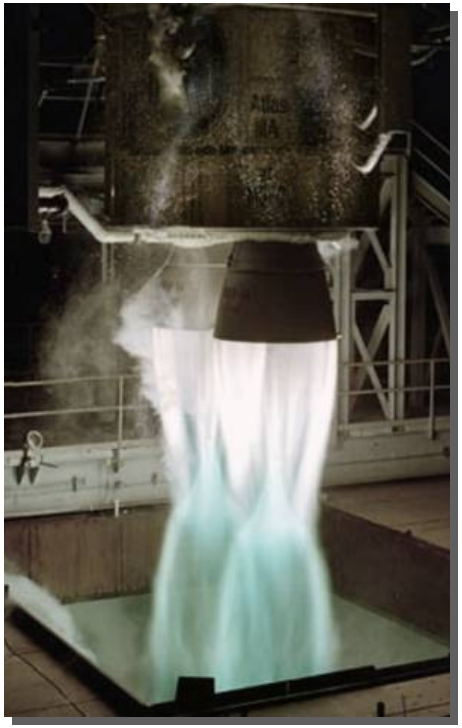
Russian RD-180 Rocket Engine for Atlas V Launch Vehicle



NASA 2010 Program Managers Challenge
Galveston, TX

"Industry Perspectives on Commercial International Program/Project Collaboration"

10 Feb 2010

Gregory J. Pech
Director, Engines & Motors Product Delivery Team
United Launch Alliance (ULA)

RD-180 Background

- **Russian Designed/Produced Engine**
  - Liquid Oxygen-Kerosene Booster Engine
  - Derived from RD-170 (Energya “Buran” Space Shuttle)
  - Fully Throttleable up to 860,000 Lbs of S.L. Thrust
  - Produced by NPO Energomash, Khimky Russia
- **First Stage Engine for Atlas III and Atlas V**
  - Commercial and Government satellite launches
  - 100% Mission Success: 25 Flights to Date
    - 13 Commercial + 12 US Government
    - NASA Launches:
      - Mars Reconnaissance Orbiter — Aug 2005
      - Pluto New Horizons — Jan 2006
      - LRO/LCROSS — Jun 2009

AC-201/Eutelsat W4
May 24, 2000
1st RD-180 Launch

RD-180 is a Core Element of the Atlas V Launch Vehicle for the USG’s Assured Access to Space

RD-180
LIQUID ROCKET SPACE PROPULSION

Contracting Relationships

Customer

ULA®
United Launch Alliance

- U.S. company est. 1997
- Contracting for production, sale, shipment and support services for RD-180 and derivative engines.

American/Russian Rocket Engine Joint Venture

50% Owner

Pratt & Whitney Rocketdyne

- Premier U.S. liquid rocket engine developer/producer
- Premier turbopump developer/producer for SSME
- Funding source for RD-180 development
- Provides RD-180 engine integration and launch support services
- Demonstrated U.S. Co-Production capability

50% Owner

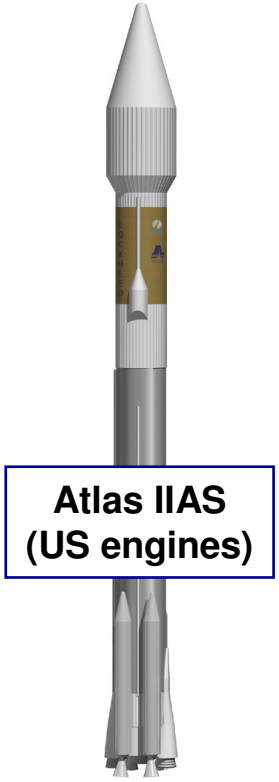
NPO Energomash

NPO ENERGOMASH

- Premier Russian liquid rocket engine developer/producer
- Developer/designer of RD-180 using RD-170 heritage
- Produces RD-180 engines for Atlas launch vehicles
- Provides engine integration and launch support services
- Provides technology transfer for U.S. Co-production

Motivation for Cooperation

- **Technologies and Performance Capabilities**
  - Currently not available in U.S.
- **US/Russia cooperative relations**
- **Dramatic capability improvements:**



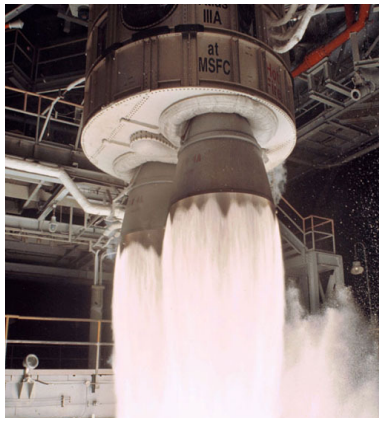
Atlas IIAS (US engines)

	Atlas IIAS	Atlas V
Reliability:	0.9876	0.9955
Payload: (GTO)	8200 lb.	10900 lb.
Cost:	8 engines	2 engines

Atlas V (RD-180)

Integration

- **Development (1996 - 1999)**
  - Designed and developed by NPO Energomash under joint program with P&WR
  - System integration by Lockheed Martin
  - Tested in both U.S. and Russia
- **Operations (1998 - Present)**
  - Manufacture & test by NPO Energomash in Khimky, Russia
  - Reviews by P&WR and Lockheed Martin in Khimky & Denver
  - Air shipment by RD AMROSS to Denver, CO
  - Integration into Atlas launch vehicle in Denver, CO
  - Air shipment of Atlas V to U.S. launch sites
  - Integration & Launch support from RD AMROSS using P&WR and NPO Energomash team in U.S.



System testing at NASA's Marshall Space Flight Center

RD-180 Engine Successfully Integrated into ULA's Atlas V Launch Vehicles and Fully Operational

Interdependencies

Stakeholders

- **Governments**
  - DoS — MOFA
  - DoD — MOD
  - DoC — MEDT
  - USAF, Navy — FSA
  - NASA
- **Industry**
  - United Launch Alliance
  - RD AMROSS
  - NPO Energomash
  - Pratt & Whitney Rocketdyne
  - Subcontractors

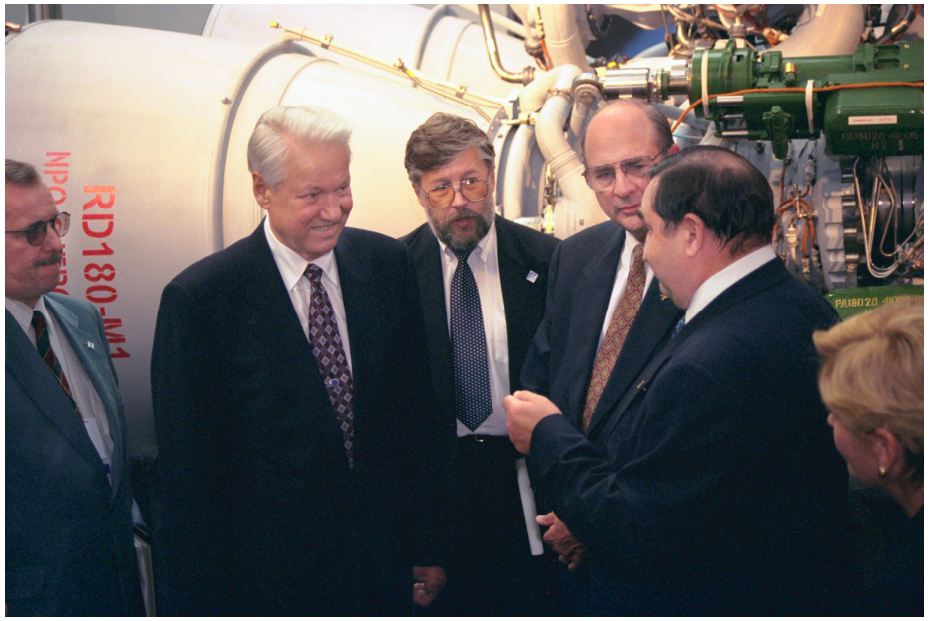
BALANCE

Interests

- **Multinational Agreement**
  - MTCR
- **Policy**
  - FSU Propulsion Systems
  - Nuclear Non-Proliferation
  - US Space Transportation
- **Fair International Trade**
- **Assured Access to Space**
- **Mission Success**
  - Technical Integration
  - Data Access
  - IV&V
- **Export Control**
  - ITAR
- **Intellectual Property**
  - Protection / Patents
- **Profitability**

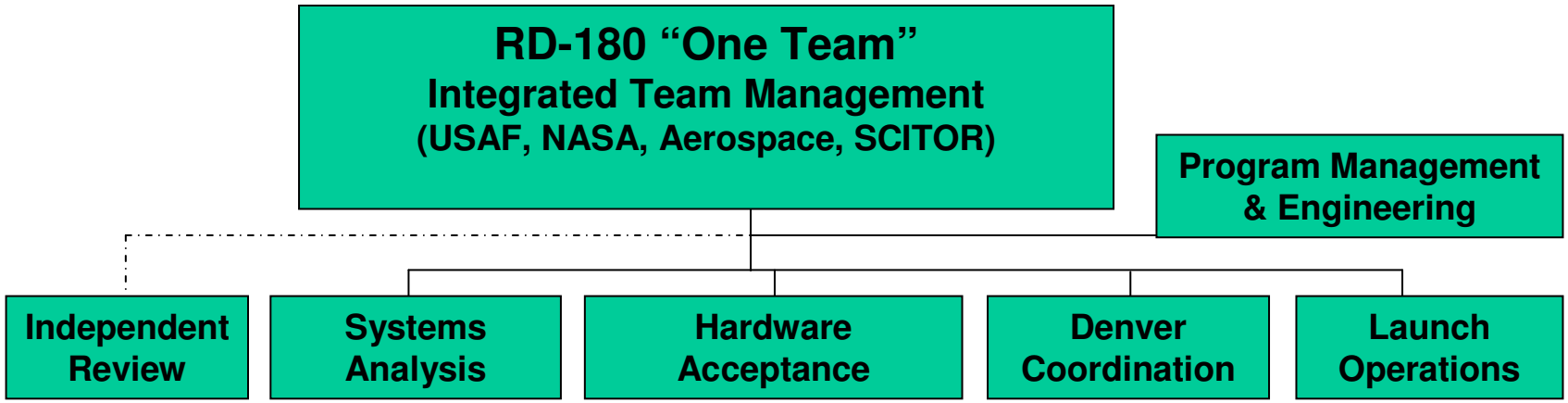
Government Involvement

- **Cooperation required by both Governments**
  - Participation at high levels at program startup (1994-1995)
  - DoD FSU Policy extension granted in Oct 2002 by Under Secretary of Defense
  - Licensing granted by both governments to allow technical integration
  - Steady improvements in RD180 data access granted by GOR Export Control
- **Active USG "One Team"**
  - Engine acceptance reviews
  - Anomaly investigations
  - Launch operations
  - Risk reduction initiatives
  - U.S. Co-Production monitoring
  - Mission Assurance Team (MAT)
  - Independent Readiness Reviews



Boris Yeltsin and Norm Augustine discussing RD180 matters.

Government Participation



- **"One Team" Charter**
  - **Provide objective, independent RD-180 launch verification**
  - **Monitor RD-180 production engine Program**
- **"One Team" Benefits**
  - **Consolidate USG technical talent**
    - Maximize technical insight and information sharing while protecting data
    - Minimize organizational duplication and overlap of efforts
  - **Minimize impact of existing barriers**
    - Multiple contracts, contracting strategies

Process in Place for USG Participation

Challenges

- **Profitability in an export-controlled environment**
  - TAA and MLA approval process can take up to 1 year from time of application
  - License restrictions make technical Integration more difficult
  - Anomaly resolutions and optimization take longer
- **Access to technical information**
  - Protection of competition-sensitive or strategic data vs. over-protection
  - Must comply with both US and Russian export laws
- **Cultural differences**
  - Language / communications
  - Contracting and business practices
  - Trusting relationships
  - Ethics

Challenging Business Environment

Program Management Recommendations

- **Know and comply with Export Laws**
  - Plan for a longer and more complex process of doing business
- **Develop business relationships with mutual benefits**
  - Understand and respect foreign supplier's constraints
  - Recognize obligations to protect intellectual property
  - Fair economic exchange for products and technologies
  - Understand and recognize cultural differences
  - Employ facilitators who understand language and business practices
  - Communicate and adhere to our Ethics
  - Seek long-term opportunities for cooperative space exploration

Great Potential for Mutual Benefits with International Partners

Summary

- **RD-180 fully operational in the Atlas V launch vehicle**
  - **Atlas cost and launch capabilities greatly improved**
  - **100% Mission Success**
- **Strong relationships established with Russian partners**
  - **Industry and Government**
- **Government support & participation critical to success**

International Cooperation Successfully Demonstrated by RD-180 Program: Foundation for Future Space Exploration